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[54] **LOCALIZED LUBRICATION OF SYRINGE BARRELS AND STOPPERS**

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[52] **U.S. Cl.** **604/230**; 604/265; 427/231

[58] **Field of Search** 427/2.28, 2.25, 427/2.12, 2.18, 2.3, 231, 240, 230, 236, 284, 434.2, 434.5; 118/76; 401/4, 5; 604/265, 230, 231, 228

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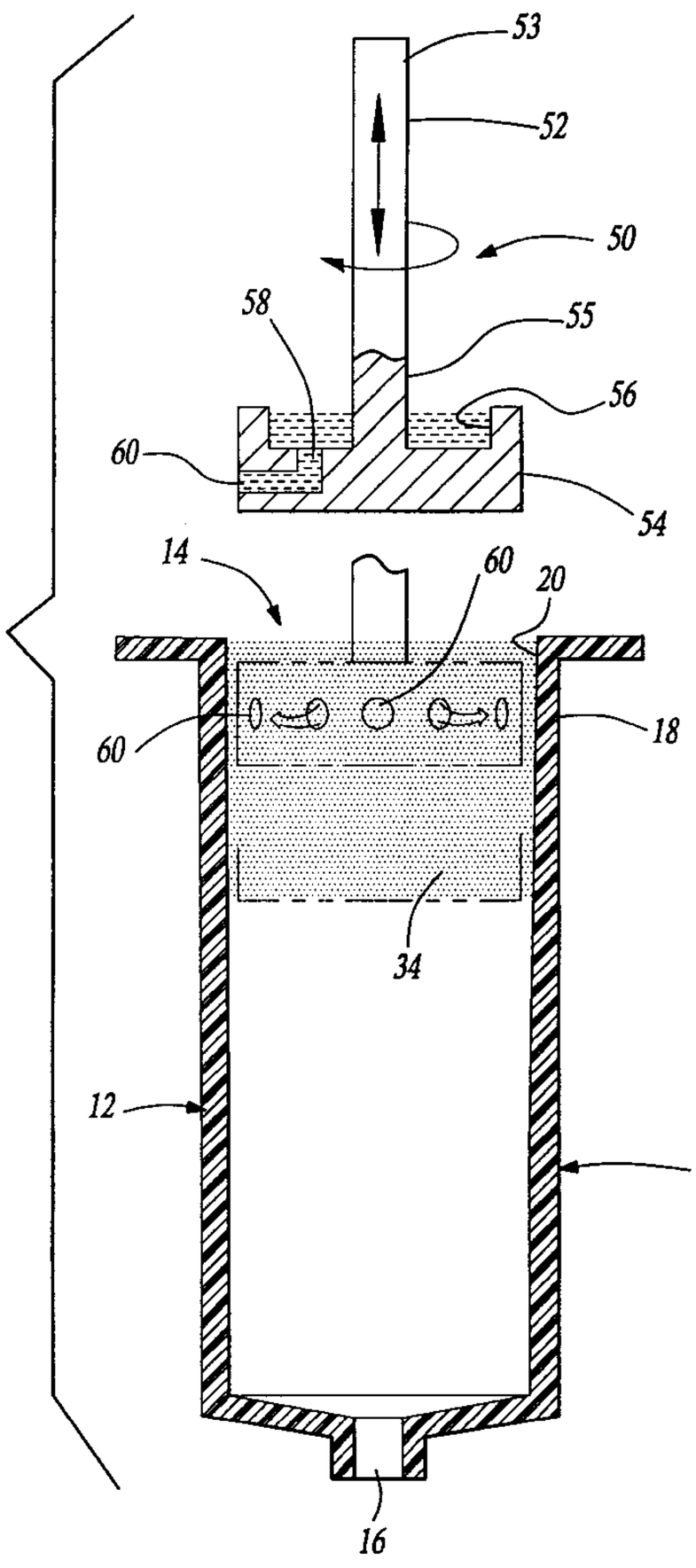
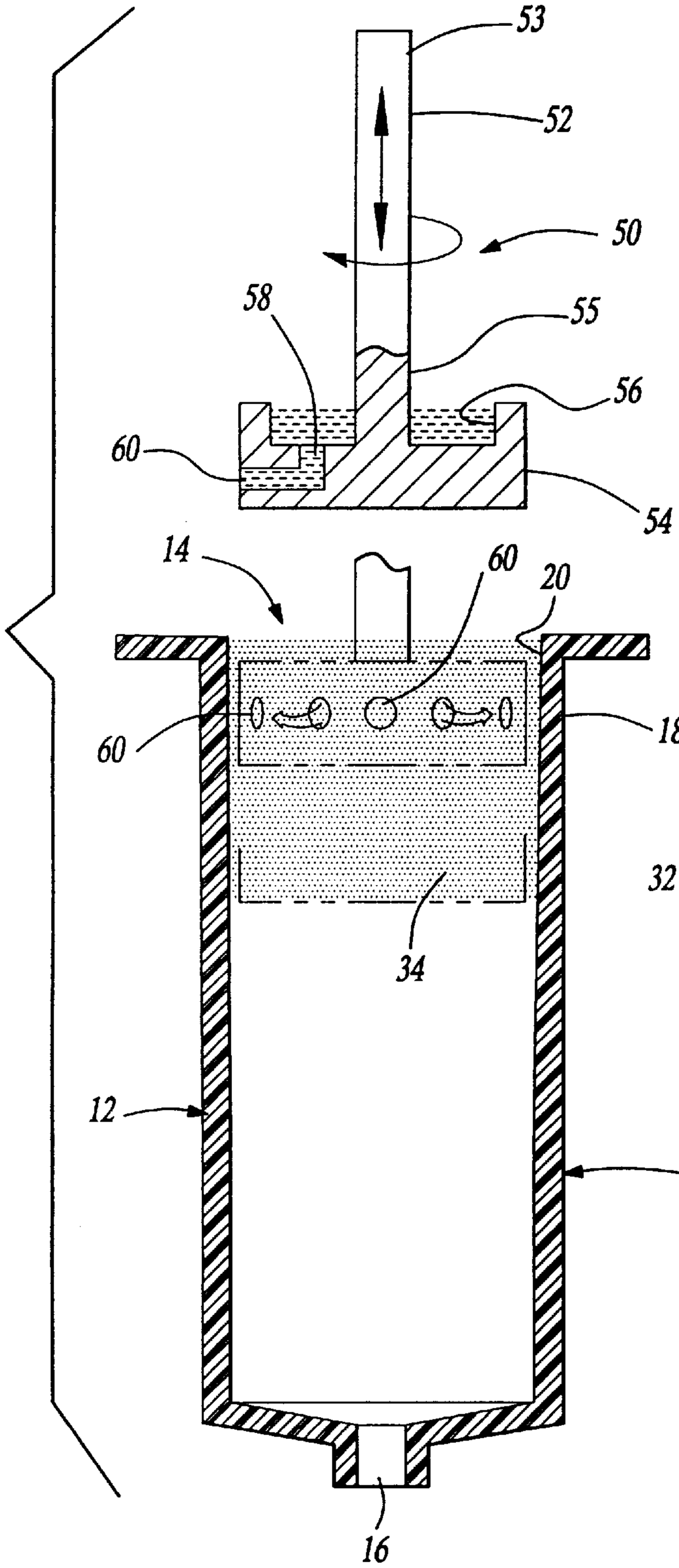
[57] **ABSTRACT**

A medical syringe assembly includes a first opening and a second opening at opposite ends of a tubular barrel having an inner wall. The inner wall includes an inner surface. A stopper having an engagement surface is slidably received in the tubular barrel and includes a portion for engaging the surface of the inner wall of said tubular barrel. A lubricant is disposed over a limited area of at least one member of the inner wall of the tubular barrel and the engagement surface of said stopper, whereby a sufficient amount of the lubricant is available to provide adequate reduction of friction between the surface of the inner wall of the tubular barrel and the engagement surface of the stopper.

6 Claims, 1 Drawing Sheet




53
52
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14
60
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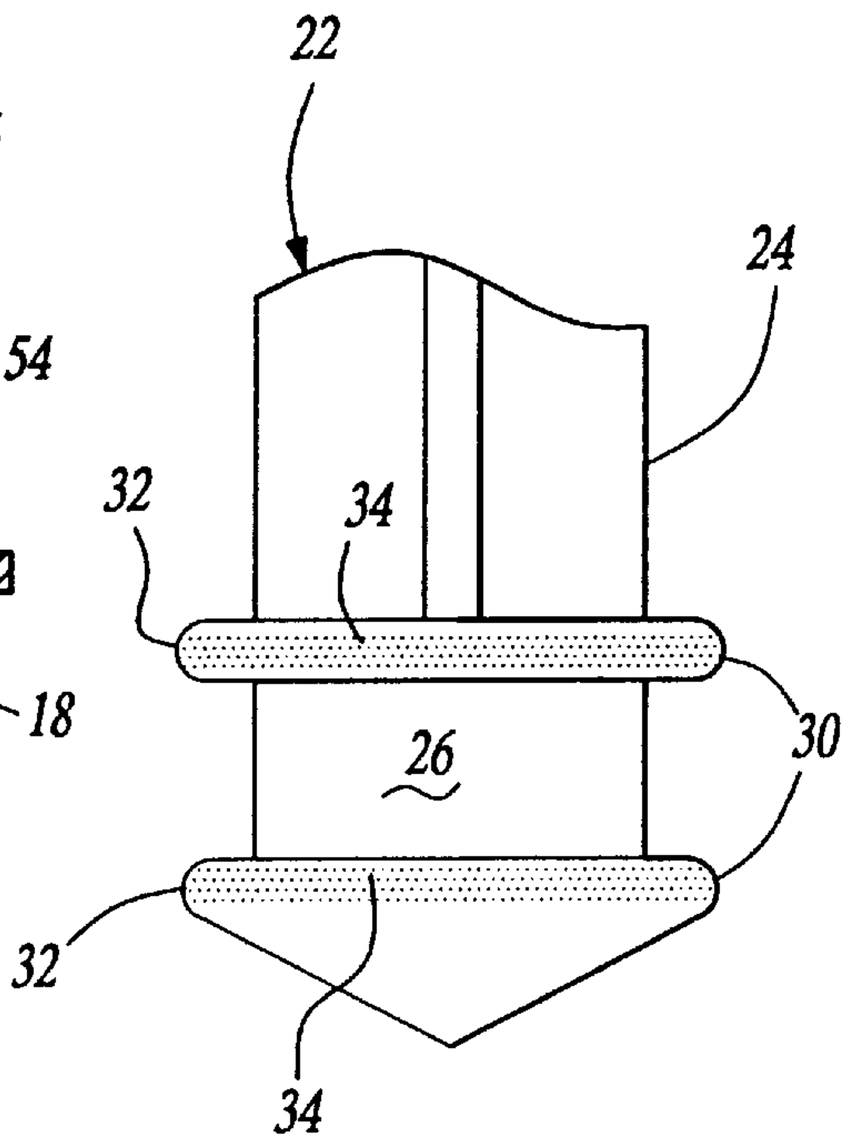
16

Fig-1


22
24
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26
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Fig-2

LOCALIZED LUBRICATION OF SYRINGE BARRELS AND STOPPERS

TECHNICAL FIELD

The subject invention relates to medical syringes and, more specifically, to the lubrication of syringe barrels and stoppers.

BACKGROUND OF THE INVENTION

By way of background, syringes typically include a tubular barrel portion and a plunger having a stopper disposed at one end. The plunger and stopper are inserted into the tubular barrel of the syringe. The stopper portion is typically made of an elastomeric material, such as natural or synthetic rubber, which engages an inner surface of the syringe tubular barrel to create a seal that facilitates ejecting a fluid from the syringe when pressure is applied to the plunger.

Traditionally, the inside of the syringe tubular barrels, whether constructed of plastic or glass, and the outside of the stoppers have been lubricated with a silicone oil to reduce the friction between the two parts. By selecting the viscosity and the amount of silicone applied to the inside of the tubular barrel and to the stopper, the friction between them is reduced or adjusted to a desired level.

In conventional syringe fabrication, silicone is applied to the syringe tubular barrels by spraying the silicone oil downwardly into the tubular barrel. This generally results in the entire inside surface of the tubular barrel being covered with silicone. Likewise, the entire stopper typically is coated with silicone oil in a batch process in which a number of stoppers are tumbled together with silicone oil. In both of these processes, the entire inside surface of the syringe barrel and the entire stopper is covered with silicone. In this case, the resultant amount of silicone applied to the syringe barrel and the stopper exceeds what is required to sufficiently reduce the friction between the two parts to a suitable level.

While medical grade silicone oils are not typically harmful, it is desirable to have a medical syringe and method for making the medical syringe that minimizes the amount of silicone used and more effectively and strategically places silicone on the syringe components to reduce the friction between the moving parts of the syringe while eliminating excess lubricant. The advantages of minimizing the amount of silicone utilized in a medical syringe include reducing or minimizing the amount of silicone which is injected into the body of a patient or subject along with the drug, preventing the leakage of silicone to the outside of the syringe thereby reducing the likelihood that the syringe will slip in the hands of a medical practitioner, and minimizing the interaction between the lubricant (silicone) and the contents of the syringe. Minimizing the interaction between the lubricant and the contents of the syringe is particularly important where syringes are pre-loaded with a particular injectable drug, which may be stored for some time before being administered to a patient.

Accordingly, it is desirable and advantageous to have a medical syringe assembly and method for making a medical syringe assembly in which lubricant is only disposed over a limited area of the syringe in a sufficient amount to provide adequate reduction of friction between the syringe barrel and the stopper.

SUMMARY OF THE INVENTION

A medical syringe assembly for administering an injectable drug includes a tubular barrel having an inner wall. A plunger includes a stopper having an engagement surface in slidable engagement with the surface of the inner wall of the tubular barrel. A lubricant is disposed over a limited area of at least one portion of the inner wall of the tubular barrel and the engagement surface of the stopper whereby a sufficient amount of the lubricant is available to adequately reduce friction between the surface of the inner wall of the tubular barrel and the engagement surface of the stopper.

The method of this invention is useful for applying a lubricant on a surface of the inner wall of a tubular barrel of a medical syringe assembly over an area extending completely circumferentially around the tubular barrel and extending axially from a first opening of the tubular barrel along a distance less than the entire length of the inner wall of the tubular barrel. The method includes providing an applicator including a container for holding the lubricant. The container preferably has a sidewall with at least one aperture. One end of the applicator is disposed into the first opening of the tubular barrel and the applicator is rotated while depositing the lubricant against the inner wall of the tubular barrel. The applicator moves axially into the tubular barrel as the applicator is rotating for a distance less than the axial length of the inner wall of the tubular barrel. The applicator is removed when the desired amount of the tubular barrel has been coated with the lubricant.

A method for coating a stopper of a medical syringe assembly with a lubricant over a circumferential area less than the total circumferential area of the stopper is also disclosed which includes providing the stopper with annular ribs, each rib including an outer surface, and pattern coating the outer surface of each rib with a lubricant. The conical area at the leading end of the stopper also should not have lubricant.

Also there is disclosed a method for coating a stopper of a medical syringe assembly with a lubricant over a circumferential area less that the total circumferential area of the stopper which includes pattern coating the outer surface of the stopper having one or more annular rings with lubricant wherein the combined axial length of the annular rings is less than the axial length of the outer surface of the stopper.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. **1** is a cross-sectional view of a syringe barrel and coating apparatus of the subject invention; and

FIG. **2** is a side view of a portion of a plunger including a stopper of the subject invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the Figures, wherein like numerals indicate like and corresponding parts throughout the several views, a medical syringe assembly is shown generally at **10**. The syringe assembly **10** is of the type to be utilized for the administration and injection of injectable drugs.

The syringe assembly **10** includes a generally cylindrical or tubular barrel **12** having a mouth opening **14** disposed at one end and an outlet **16** disposed at the opposite end. A continuous circumferential wall **18** defines the tubular barrel **12**. A lubricant **34** is disposed on a portion of an inner surface **20** of the wall **18**. The lubricant **34** is preferably only

disposed over a limited area of the inner surface **20** of the tubular barrel **12**.

Referring specifically to FIG. **2**, a plunger **22** includes a shaft portion **24** having a stopper **26** disposed at its distal end. The stopper **26** is preferably constructed of an elastomeric material such as a synthetic rubber which conforms to the dimensions of the barrel **12**, defined by the wall **18**, to provide a seal therebetween. The stopper **26** includes a conical portion **28** disposed at the most distal end of the stopper **26**. The stopper **26** also includes at least one annular rib **30** that includes an engagement surface **32** for engaging the inner surface **20** of the wall **18** of the tubular barrel **12**. The engagement surface **32** of each rib **30** preferably is coated with the lubricant **34** to aid in the reduction of friction between the stopper and the inner surface **20** of the tubular barrel **12**.

The tubular barrel **12** and plunger shaft **24** can be constructed of any suitable material. For example, the tubular barrel **12** and the plunger shaft **24** can each be constructed of a suitable material such as glass or plastic. Plastics are the preferred materials as they are more easily manufactured and can be easily disposed.

The inner surface **20** of the tubular barrel **12** extends completely circumferentially around the inner wall **18** and extends axially from the mouth **14** of the tubular barrel **12** to the outlet **16**.

Referring specifically to FIG. **1**, a coating head assembly **50** for applying the lubricant **34** to the inner surface **20** of the tubular barrel **12** is shown schematically. The coating head assembly **50** includes a spindle **52** which includes a proximal end **53** and a distal end **55**. The proximal end **53** can be attached to a mechanism (not shown) for rotating the spindle **52** and moving it axially (i.e., up and down according to the drawing). A coating head **54** is attached to the distal end **55** of the spindle **52**. The coating head **54** includes a lubricant reservoir **56** for supplying lubricant **34** for coating the inner surface **20** of the tubular barrel **12**. A passageway **58** is disposed in communication with the reservoir **56** and at least one aperture **60** disposed in the coating head **54** for permitting the lubricant **34** to exit the reservoir and be applied to the inner surface **20** of the tubular barrel **12**.

In operation, the coating head assembly **50** is placed into the mouth **14** of the tubular barrel **12** and is then axially displaced downwardly from the mouth **14** of the tubular barrel **12**. The assembly **50** only moves a distance sufficient to coat a preselected portion of the inner suface **20** of the wall **18**. Following the coating of the selected portion of the inner surface **20** of the tubular barrel **12**, the coating head **54** is withdrawn from the tubular barrel **12**.

The amount of lubricant **34** applied to the inner surface **20** of the tubular barrel **20** can be adjusted by selecting a predetermined pattern for the apertures **60** disposed in the rotating coating head **54**, by varying the size of the apertures **60**, the speed of rotation of the coating head **54**, the depth of travel of the coating head **54**, and controlling the amount of lubricant which is initially deposited into reservoir **56** and the amount which is radially dispensed against the inner surface **20** of the tubular barrel **12**.

The application of the lubricant **34** preferably extends completely circumferentially around the inner surface **20** but extends axially only from near the mouth **14** of the tubular barrel **12** along a distance less than the entire length of the wall **18** of the tubular barrel **12**. That is, the lubricant **34** preferably is disposed only on the inner surface **20** of the tubular barrel **12** at an area extending completely circumferentially around the tubular barrel **12** but extending axially only from near the mouth **14** of the tubular barrel **12** along a distance which is only a portion of the length of the wall **18** of the tubular barrel **12**. In the preferred embodiment, the lubricant **34** extends axially from near the mouth **14** of the tubular barrel **12** along a distance that is only slightly greater than the length of the stopper **26** of the plunger **22**. Since the stopper **26** will typically be maintained near the mouth **14** in a prefilled syringe assembly, the lubricant **34** need only coat the corresponding area of the inner wall **20** to achieve the desired lubrication.

Also in order to minimize the amount of lubricant **34** utilized in the syringe assembly **10**, the lubricant preferably is disposed on the outer surface **27** of the stopper **26** in an annular pattern having an axial length smaller than the axial length of the stopper **26**. That is, the lubricant **34** preferably is disposed only on discrete annular portions of the stopper **26**. Preferably, as described above, the stopper **26** includes at least one annular rib **30** with the lubricant **34** disposed only on the outer or engagement surface **32** of each of the annular ribs **30**. Since the engagement surface **32** of each rib **30** is the only portion of the stopper **26** in contact with the inner surface **20** of the wall **18** of the tubular barrel **12**, by applying the lubricant **34** to only the engagement surface **32** of each rib **30**, the total amount of lubricant utilized can be greatly reduced while reducing friction between the stopper **26** and the tubular barrel **12**.

The application of the lubricant to the selected areas of the stopper **26** can be accomplished by adapting known methodologies from the printing arts such as pattern coating or by transferring a thin layer of lubricant to selected areas of the stopper **26** by rolling and pressing. Additionally, lubricant **34** can be applied to the selected areas of the stopper **26** by masking or covering those portions of the stopper **26** to which no lubricant **34** is to be applied, while applying, preferably by spraying, the lubricant **34** onto the remaining, unmasked portions of the stopper **26**.

The lubricant **34** is preferably a medical grade silicone oil. Other suitable medical lubricants, such as glycerin, may be utilized without departing from the spirit of the invention.

The invention has been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation.

Modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the following claims, the invention may be practiced otherwise than as specifically described above.

What is claimed is:

1. A method of lubricating a medical syringe assembly having a tubular barrel with an inner wall using an applicator that is selectively received within the tubular barrel comprising the steps of:

(a) moving the applicator into the tubular barrel;

(b) moving the applicator within the tubular barrel to thereby deposit a lubricant on the inner wall of the tubular barrel;

(c) moving the applicator a preselected axial distance within the tubular barrel that is less than an axial length of the inner wall of the tubular barrel while performing step (b); and

(d) removing the applicator from the barrel when the desired portion of the tubular barrel has been lubricated.

2. A method according to claim **1**, wherein the preselected axial distance of step (c) is a relatively minor portion of the axial length of the inner wall of the tubular barrel.

3. A method of claim 1, wherein step (b) is performed by rotating the applicator within the barrel.

4. A method of claim 1, wherein the syringe assembly includes a stopper and the method further comprises coating a portion of the stopper with a lubricant over a circumferential area less than the total circumferential area of the stopper.

5. A method of claim 4, wherein the stopper includes at least one annular rib having an outer surface and the method further comprises pattern coating the outer surface of the rib with the lubricant.

6. A method according to claim 5, wherein the lubricant is silicone.

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